In What Ways Do Health Behaviors Impact Academic Performance, Educational Aspirations, and Commitment to Learning?

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April 2018

Paper presented at the annual meeting of the
American Educational Research Association, New York, NY.

Citation:

Cabrera, J. C., Rodriguez, M. C., Karl, S. R., & Chavez, C. (2018, April). *In what ways do health behaviors impact academic performance, educational aspirations, and commitment to learning?* Paper presented at the annual meeting of the American Educational Research Association, New York, NY.

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Abstract

Research studies on the health behavioral choices of students have made it clear that adhering to healthy behaviors has a positive association with academic performance and attainment. However, most educational studies have investigated these behaviors individually, while others have investigated only a few factors at a time. This study examined the associations between multiple health behaviors (i.e., physical activity, nutrition, sleep, and substance use) and the academic performance (using grade point average as a proxy), commitment to learning, and educational aspirations of high school students. Regression results from two different survey samples (N = 79,339 and 81,885) from 2013 and 2016 show that healthy behavioral choices are positively associated with academic performance, commitment to learning, and educational aspirations.

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The positive associations between a healthy lifestyle and academic outcomes continue to provide much needed information to policymakers and school personnel in order to address both health and academic problems among middle and high school students. For example, multiple studies researchers have found that middle and high school students who are less physically active have academic achievements far below those who are more active (e.g., Carlson et al., 2008). Similarly, several studies have shown that students who make responsible choices regarding food consumption (e.g., Alaimo, Olson, & Frongillo, 2001) and drug or alcohol use (e.g., Newbury-Birch et al., 2009) have better health and academic outcomes than their age-related peers who make unhealthy choices. Such research provides school districts with information necessary to implement in-school and after-school programs that have positive effects on the academic outcome of students.

The associations between the healthy choices students make and academic outcomes are positive; in other words, the healthier the choices a student makes, the better the student performs in school and the higher the likelihood the student will pursue a higher education. However, it remains unclear whether positive associations between healthy choices (defined below) and academic outcomes still exist once multiple behaviors are analyzed concurrently. The purpose of this study is to simultaneously examine the associations of several behaviors, including physical activity, sleep, eating behaviors and food choices, and substance use, with academic performance, commitment to learning, and educational aspirations in order to understand which health behaviors (or what combination of health behaviors) have the stronger effects on the academic journey of a student.

Perspective

Healthy behaviors have an impact on academic performance and attainment. Within the plethora of behavioral research, several behaviors have been linked to academic outcomes, including physical activity, eating behaviors and food choices, sleeping behaviors, and tobacco, alcohol and drug use. In short, students that are food secure, eat regular meals, consume a

sufficient amount of fruits and vegetables, sleep a recommended number of hours, do not use tobacco, alcohol or illicit drugs, and are physically active consistently, do well in school.

The evidence regarding the positive academic outcomes of physical activity is strong, however, adolescents are not meeting the recommended levels of physical activity. According to the *Physical Activity Guidelines for Americans*, adolescents should partake in at least 60 minutes of physical activity every day, at least five days a week (ODPHP, 2008). Students who meet these guidelines and partake in higher rates or intensity of physical activity show improved academic outcomes compared to students with low levels of physical activity (Carlson et al., 2008; Castelli, Hillman, Buck, & Erwin, 2007; Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Field, Diego, & Sanders, 2001; Nelson & Gordon-Larsen, 2006; Shephard, 1996). Unfortunately, the rates of physical activity for high school students is abysmal, with only a fraction of high school students (34.7%) meeting the recommended levels of physical activity (CDC, 2007). These stark statistics, showing the low levels of physical activity that high school students partake in, and the links between physical activity and physical and mental health have been the primary drivers of governmental physical activity and food consumption efforts, such as *Let's Move!* and *My Plate*, in order to raise a healthier and smarter generation of students (USDA, 2015; Let's Move!, n.d.).

Healthy food consumption among children and teenagers has also been shown to be a significant factor for academic, health, and psychosocial outcomes. On the other hand, lack of access to food has been found to be a detrimental factor to the academic success for many. Food-insufficient teenagers, those whose family members sometimes or often do not get enough food to eat, are more likely to have been suspended from school, have difficulty getting along with other children, and tend to exhibit poorer academic outcomes (Alaimo, Olson, & Frongillo, 2001; Jyoti, Frongillo, & Jones, 2005). Aside from food security, the consumption of a daily breakfast, lunch, and dinner, including grains, fruits, or vegetables, has been shown to improve health outcomes (Smith, Gall, McNaughton, Blizzard, Dwyer, & Venn, 2010), cognitive abilities, and academic outcomes (Adolphus, Lawton, & Dye, 2013; Hasz & Lamport, 2012). Unfortunately, food security is a challenge for a large percentage of families throughout the United States (e.g., Ferris, 2012), and large number of students, particularly low-income students and students of color, skip meals on a consistent basis (Rotakhina, 2015).

Regarding sleep behaviors, the evidence on sleep quality and quantity indicates that they are closely related to academic performance and cognition (Curcio, Ferrara, & Gennaro, 2006; Taras & Potts-Datema, 2005). Contrary to this evidence, analyses of the National Longitudinal Study of Adolescent Health indicate short total sleep time is not associated with changes in emotional and academic functioning (Asarnow, McGlinchey, & Harvey, 2014). Given the ample evidence of the negative effects of inadequate sleep on cognitive function (e.g., sleepiness, inattention, and cognitive deficits that impact daytime functioning; Beebe, 2011), the need to further analyze the effects of sleep on academic performance is warranted.

Alcohol, tobacco, and drug use have detrimental effects on the health of an individual, as well as on their academic performance or attainment. Middle and high school students who consume alcohol, especially those who binge drink, tend to show acute and chronic health problems, lower GPAs, higher unexcused absences, and trouble at school (Newbury-Birch et al., 2009; Rees, 2014). Similarly, students who use illicit drugs perform poorly in school and are more likely to drop out (Rees, 2014). Unfortunately, there are large numbers of students that use alcohol, tobacco, or drugs. Descriptive results from the 2014 *Monitoring the Future Survey* show that alcohol and drug use are prevalent among high school students, with 23.5% of 10th graders reporting past month-use of alcohol, and 18.5% of 10th graders reporting past month-use of illicit drugs (National Institute on Drug Abuse, 2014).

The purpose of this study is to model health behaviors simultaneously through regression analyses using data from the Minnesota Student Survey. We hope to replicate the associations that have been observed from previous studies and clarify the picture regarding which behaviors have stronger associations with commitment to learning, academic outcomes, and educational aspirations.

Methodology

Data

Minnesota Student Survey (MSS). The current research paper entails a secondary analysis of the 2013 and 2016 MSS databases. Data from the MSS are provided by public school students in Minnesota (MN) via local public school districts and managed by the MSS Interagency Team, including the MN Departments of Education, Health, Human Services, Public Safety, and Corrections. The MSS is administered every three years to students in public schools in grades 5,

8, 9, and 11 (Minnesota Department of Education, 2016). In 2013, a total of 162,034 students participated, and 168,733 students participated in 2016.

Measures

For the purpose of this study, a number of questions were chosen from the MSS to serve as control, independent, and dependent variables. The following control variables were included in the regression analyses (described below): the self-reported gender of the student; grade; race/ethnicity; attendance; and a socioeconomic status proxy (SES; as measured by a single item asking the free and reduced-price lunch status of the student). Predictor variables included in the analyses were: rate of physical activity; hours of sleep; skipping lunch or other meals; servings of fruits, and vegetables; fast-food and empty calorie consumption; water and dairy consumption; and, tobacco, alcohol and drug use. Outcome variables included academic performance (i.e., self-reported GPA), commitment to learning, and educational aspirations (i.e., post high school plans). (See Table 1 for descriptive statistics of these variables.)

Individual control variables. Student-level control variables include gender (male/female); grade (ninth/eleventh); SES (students were categorized as low SES if they reported receive free or reduced-price lunch at school); attendance (students were categorized as low attendance if they reported that they skipped or cut one or more times a full day of school or classes without being excused during the last 30 days); and race/ethnicity (dummy variables for African American, Asian American, Hispanic American, and Multiracial students with White as reference group).

Individual predictors. Healthy behavioral choices (e.g., physical activity) are those that have shown to be related to academic achievement, attainment, and resilience. Several survey items were chosen to assess physical activity, sleep, eating behaviors and food choices, and substance use.

Physical activity. Physical activity was assessed by a single survey item where students reported the number of days being physically active for a total of at least 60 minutes per day (M = 5.0, SD = 2.3).

Sleep. Sufficient sleep was assessed by a single survey question where students reported the number of hours of sleep they get during a typical school night (M = 6.9, SD = 1.3).

Eating behaviors and food choices. Four measures assessed the eating behaviors and food choices of students, they include food security, intake of healthy foods, intake of healthy drinks, and junk-food consumption. Food security was assessed using two survey items with different response categories. The students responded to questions about skipping meals due to economic hardship of the family and whether the students had lunch during the school week. Intake of healthy foods was assessed using two questions of similar response categories. These questions inquired about the daily consumption of fruits (including 100% fruit juices) and green salads, potatoes, carrots, or other vegetables; 14 or more servings were considered the benchmark of a healthy choice as it met the daily serving recommendations of fruits and vegetables (from USDA, 2015). Intake of healthy drinks was assessed with two survey items with the same response categories. The daily water and dairy consumption of milk and water of 3 or more cans, bottles, or glasses per day (a total of 6 together) was the benchmark for the daily serving recommendations (USDA, 2015). Junk-food consumption was assessed from a combination of four items inquiring empty calorie consumption from sports, energy, and sugar-sweetened drinks (e.g., Gatorade, Red Bull, and lemonade, respectively), and pop or soda, and one item of different category response inquiring their frequency of eating from a fast food restaurant.

A four-factor confirmatory factor analysis using the `cfa` function in the `lavaan` package (Rosseel, 2012) in the R 3.4.4 statistical software (R Core Team, 2018) was fit to the data for the four measures of eating behaviors and food choices. The global fit indices indicate good fit, where RMSEA is 0.046, CFI is 0.923, and TLI is 0.889. The standardized factor loadings ranged from 0.27 to 0.95 (7/11 are over 0.50). Overall, these fit indices and factor loadings support the use of these items as indicators of measures of eating behaviors and food choices. Common guidelines were followed for adequate fit indices where RMSEA is below 0.10, CFI and TLI are greater than .90 (Brown, 2015; Kline, 2011), and standardized factor loadings are 0.40 or higher (Brown, 2015); although, note that in many factor analytic studies of research surveys, standardized factor loadings of 0.30 are often used to define salient loadings.

Substance use. Tobacco, alcohol, and marijuana use was assessed using three survey items with identical response categories where students reported how often they used one of the three substances, ranging from never to daily. The three questions were dichotomized differently based on the severity of the substance on health and academic outcomes. Tobacco use was dichotomized whether a student used tobacco daily. Alcohol use was dichotomized whether a student used it

daily, once a week, or twice a month. Marijuana use was dichotomized whether a student used marijuana daily, once a week, twice a month, or once a month.

Dependent variables. The purpose of the current analysis is to investigate the associations between health behaviors (as described above) and academic performance, commitment to learning, and educational aspirations.

Academic performance. The academic performance of students was assessed by calculating one survey item where students reported the typical grades they received during their current school year (e.g., "Mostly As," "Mostly Bs"), which were converted to a 4.0 scale (M = 3.1, SD = 0.9).

Commitment to Learning (CtL). Much research has been done with CtL (described as a developmental skill) by Search Institute (2013) highlighting that CtL is highly associated with better grades; succeeding in and finishing high school and enrolling in college; managing stress; leadership; and, valuing diversity (e.g., Scales, Benson, Roehlkepartain, Sesma, & van Dulmen, 2006; see Scales, Roehlkepartain, & Shramko, 2017).

The CtL scale was previously constructed with eight survey items, e.g., caring about doing well in school, paying attention in class, going to class prepared (Rodriguez, 2017; see Appendix A). Two primary sources of validity evidence for the CtL scale include content-related evidence (documented in Benson, 1990, 2002; Benson et al., 2006; and Search Institute, 2013) and internal-structure or construct-related evidence (documented in the MSS Technical Report, Rodriguez, 2017). To support construct-related inferences, the internal structure of the measure was evaluated through confirmatory factor analysis (using Mplus v. 7; Muthén & Muthén, 2012) and differential item functioning analyses by race/ethnicity, gender, and grade (using Winsteps v. 3.92; Linacre, 2016; with results summarized in Rodriguez, 2017). The global fit indices indicate adequate fit, where RMSEA is 0.11, CFI is 0.95, and TLI is 0.91. The standardized factor loadings ranged from 0.35 to 0.79 (5/8 are over 0.50; see appendix A). Common guidelines for fit indices were the same as discussed above. The CtL measure was scored using the partial credit Rasch model in Winsteps 3.92 (Linacre, 2016). The partial credit Rasch model allows each item to have its own structure (given the ordinal nature of the response scales) and places, persons, and items onto the same scale. The Rasch reliability of the measure was also adequate, 0.70. Overall, these fit indices and factor loadings support the use of these items as indicators of the CtL developmental skill measure.

Moreover, since the measure is not used at the individual level, it provides a strong indicator of developmental support at the group level, which is the intended level of analyses.

Educational aspiration. Educational aspiration was derived from one survey item regarding post-high school plans where students were asked about the main thing they planned to do right after high school, an item with nine response options. The nine response options were dichotomized whether students plan to attend a two- or four-year community, technical college, or university versus other plans.

Procedure

Regression analyses. Ten regression models were analyzed for each dependent variable (five each with the 2013 and 2016 data); for a total of 30 regression models. In order to differentiate the amount of variance explained by each of the four health behaviors, regardless of the number of items each one contains (e.g., eating behaviors that include four distinct variables), the regression analyses were built sequentially. The first stage included the control variables, physical activity variables were added in the second stage, sleep variables were added in the third stage, variables of eating behaviors and food choices were added in the fourth stage, and the fifth stage added the substance use indicators (see Table 2 for an example). The variables were chosen to be entered into the model as described given how much each variable can be manipulated by the students themselves, parents, school staff or teachers, or other stakeholders such as school district staff, and policy makers. For example, daily physical activity recommendations could be met by holding physical education classes every day for at least 60 minutes, a decision that can be readily made by school districts. On the other hand, several initiatives to thwart the use of tobacco, alcohol, and marijuana, during adolescence, have had little impact on middle and high school students' use.

Results

The results show that the four health behaviors described in this study are associated with academic performance, commitment to learning, and educational aspirations, after controlling for demographic variables in both 2013 and 2016.

Sample

Regression analyses were performed to estimate the associations between health behaviors and the commitment to learning, academic performance, and educational aspirations of ninth and eleventh grade students, including 79,339 from the 2013 administration year and 81,885 from 2016. Data from grades five and eight did not include all the survey items included in the high school survey, therefore, the middle school data was not included in this report. The majority of the combined sample is Caucasian (72.1%) and about half of the students are female (49.6%). Students who reported being American Indian, Pacific Islander, or did not report their race were dropped from the analyses because there were few in number from the total sample (1.0%, 0.2%, and 0.9%, respectively). Consequently, the total student sample size was reduced with no major subgroup changes noted; ethnic minorities compose 26.4% of the final sample (Asian Americans = 6.0%, African Americans = 5.6%, Hispanic Americans = 8.0%, and Multiple Races, Non-Hispanic = 6.8%), and females compose 49.8% of the final combined sample (N = 157,752). Each administration year is analyzed separately as a cross-validation check.

Academic Performance

For the academic performance models, (a) there was a significant main effect for physical activity on GPA, (standardized) $\beta = 0.11$ and $\beta = 0.10$, ps < .001, explaining 1.0% and 0.5% of additional variance, controlling for gender, grade, SES, race/ethnicity, and attendance, with the 2013 and 2016 data, respectively (Model 2, Tables 2 and 3); (b) there was a significant main effect for hours of sleep, $\beta = 0.11$ and $\beta = 0.12$, ps < .001, explaining 1.1% and 1.4% of additional variance (Model 3, Tables 2 and 3); (c) all eating behaviors and food choice variables significantly predicted GPA (see Model 4, Tables 2 and 3), explaining an additional 5.2% of variance (*adj*. R^2 = 21.7%, $F(14, 64376) = 1273.3$, $p < .001$) for the 2013 data and 4.4% of variance (*adj*. R^2 = 22%, $F(14, 72503) = 1462.5$, $p < .001$) for the 2016 data; and, (d) all substance use variables significantly predicted GPA (see Model 5, Tables 2 and 3), explaining an additional 1.5% of variance (*adj*. R^2 = 23.1%. $F(17, 58040) = 1028.9$, $p < .001$) with the 2013 data and 1.3% of variance (*adj*. R^2 = 23.3%. $F(17, 67926) = 1215$, $p < .001$) with the 2016 data. Overall, health behaviors explained 8.7% and 7.6% of additional variance in GPA with the 2013 and 2016 samples, respectively, controlling for demographic variables. Similar to earlier studies, physical activity was positively associated with GPA, suggesting that more physical activity was associated

with higher GPA; receiving sufficient sleep is positively associated with higher GPA, suggesting a higher number of hours of sleep was associated with higher GPA; not eating lunch or skipping meals, not meeting the daily recommended servings of fruits or vegetables, drinking sweetened, sports, or energy drinks, eating junk food, and not meeting the daily recommended servings of milk and water were negatively associated with GPA, suggesting that unhealthy eating behaviors or choices were associated with lower GPA; and, substance use was negatively associated with GPA, suggesting a higher frequency of tobacco, alcohol, or marijuana use was associated with lower GPA. The health behavior variables explaining the most variance in GPA were eating behaviors and food choices, followed by substance use and sleep, and physical activity.

Commitment to Learning

The results for the commitment to learning (CtL) outcome were fairly similar to those above. There was a significant effect for physical activity on CtL, $\beta = 0.11$ and $\beta = 0.12$, ps < .001, explaining 1.1% and 1.3% of additional variance with the 2013 and 2016 data, respectively (Model 2, Tables 4 and 5); (b) there was a significant effect for hours of sleep, $\beta = 0.17$ and $\beta = 0.19$, ps < .001, explaining 2.9% and 3.6% of additional variance (Model 3, Tables 4 and 5); (c) all eating behaviors and food choice variables significantly predicted CtL (see Model 4, Tables 4 and 5), explaining an additional 4.2% of variance (*adj*. $R^2 = 14.1\%$, $F(14, 64580) = 760.6$, $p < .001$) for the 2013 data and 4.1% of variance (*adj*. $R^2 = 14.6\%$, $F(14, 72638) = 884.7$, $p < .001$) for the 2016 data; and, (d) all substance use variables significantly predicted CtL (see Model 5, Tables 2 and 3), explaining an additional 2.4% of variance (*adj*. $R^2 = 16.5\%$. $F(17, 58135) = 677.2$, $p < .001$) with the 2013 data and 1.9% of variance (*adj*. $R^2 = 16.4\%$. $F(17, 68039) = 787.1$, $p < .001$) with the 2016 data. Overall, health behaviors explained 10.5% and 10.8% of additional variance in CtL with the 2013 and 2016 samples, respectively, controlling for demographic variables. The CtL variance explained by the health behaviors is slightly higher than those explaining GPA.

Physical activity was positively associated with CtL, suggesting that higher number of days of partaking in physical activity were associated with higher commitment to learning scale scores; getting sufficient sleep was positively associated with higher CtL scores, suggesting that more sleep is associated with higher commitment to learning; all healthy eating behaviors and food choices were positively associated with higher CtL, suggesting that being food secure, eating healthy foods, drinking healthy drinks, and avoiding junk food were associated with higher

commitment to learning; and, substance use was negatively associated with CtL, suggesting that avoiding relatively frequent use of tobacco, alcohol, or marijuana use, was associated with higher commitment to learning scores among the high school students. The variables explaining the most variance in CtL were eating behaviors and food choices, followed by sleep, substance use, and physical activity. In contrast to the models explaining academic success, the amount of sleep students explained more variance of CtL than substance use.

Academic Aspirations

Given that the academic aspiration outcome was binary (i.e., whether students plan to attend a two- or four-year college/university), the effect sizes for the predictor variables are expressed as odds ratios (see Tables 6 and 7). In summary, (a) the odds of planning to attend a college/university after high school increases by a multiplicative factor of 1.06 per additional day of physical activity in the 2013 data and a multiplicative factor of 1.07 per additional day of physical activity in the 2016 data; (b) similarly, the odds of planning to attend a two- or four-year college/university increases by 14% per additional hour of sleep in 2013 and by 13% in 2016; (c) out of all the eating behaviors and food choice variables in the 2013 data, consumption of healthy drinks did not significantly predict planning to attend a college/university (see Model 4, Tables 6), on the other hand, for every unit change of food security and consumption of healthy food, the odds of planning to attend a college/university is increased by 56% and 13%, respectively, while avoiding junk food increases the odds of attending a college/university by 19%, controlling for gender, grade, SES, race/ethnicity, and attendance; however, for the 2016 data, all eating behaviors and food choice variables significantly predicted planning to attend a college/university: the odds of attending a college/university after high school increases by a multiplicative factor of 1.51, 1.07, and 1.11 per every additional unit change in food security, consumption of healthy food, and consumption of healthy drinks, respectively, while avoiding junk food increases the odds by 31%, controlling for demographic variables; and, (d) the odds of attending a college/university after high school are much higher for students who do not use tobacco daily (92%), or alcohol daily, once a week, or twice a month (21%) for the 2013 data, while for the 2016 data, the odds are higher for students who do not use tobacco daily (109%), slightly lower for usage of alcohol daily, once a week, or twice a month (14%), and statistically significant for marijuana daily, once a week, twice a month, or once a month (21%). Healthy drink consumption and marijuana use did not predict plans for college/university attendance in the 2013 data, but they both statistically predicted

attendance plans in the 2016 data. In short, the health behaviors, except for the healthy drink consumption and marijuana use in the 2013 data, had a positive relationship with academic aspiration, with increasing the odds of students planning to attend a two- or four-year community, technical college, or university ranging from 5% to 109%.

There was a consistent predictive effect and direction of relationship from the four health behaviors (i.e., physical activity, sleep, food behaviors and choices, and substance use) across all three outcome variables (i.e., academic performance, commitment to learning, and educational aspirations), explaining a significant amount of variance across both 2013 and 2016 data. There are several limitations to the study discussed below.

Discussion

This study suggests that health behaviors are related to academic performance, commitment to learning, and educational aspirations. A number of interesting findings about the three outcomes were observed and merit further investigation.

The findings in this study suggest that the more days a student partakes in physical activity of at least 60 minutes, the higher their grade point average (GPA), commitment to learning, and odds of planning to attend a two- or four-year community, technical college, or university. These data are consistent previous studies. Additionally, these associations were still present when the other predictors were added to the model.

Similarly, these results suggest that for every additional hour of sleep a student gets on a school night, the higher their GPA, commitment to learning, and odds of planning to attend a two- or four-year college/university. This suggests that sleep has a close relationship with academic performance and functioning in these data. The findings in this study match those of Curcio et al., 2006 and Taras and Potts-Datema, 2005. Note that these positive associations were present when controlling for demographic variables and other explanatory variables were in the model.

These data also suggest that healthy eating behaviors and healthy food choices are associated with higher GPA, commitment to learning, and planning to attend college/university after high school. As previous research studies have highlighted, people with food security who consume daily meals that include fruits, veggies, or healthy drinks, and avoid junk food, exhibit better academic outcomes, cognitive abilities, and improve health outcomes. Further investigation

is warranted regarding healthy drinks since they were not significantly associated with educational aspirations in the 2013 data. Further, limitations regarding the survey items are noted here as the items did not include all possible healthy foods or food choices, for example, candy bar consumption, intake of grains, dairy (aside from milk), or meats, were not asked in the survey. Secondary data analyses are usually subject to these limitations.

Similar to past research studies, substance use was negatively associated with GPA, commitment to learning, and odds of planning to attend college/university. These results are consistent with previous studies with similar outcomes. Abstaining from frequent use of tobacco, alcohol, and marijuana have an independent predictive effect on all three outcomes described above, except for marijuana usage on post-high school plans in the 2013 data. Further investigation for the effects of marijuana use is warranted in models that can include multiple health behaviors.

Lastly, as explained above, the variables were entered into each model according to the degree by which they could be manipulated by the student themselves, parents, school staff, teachers, district staff, policy makers, or other stakeholders. Therefore, physical activity was added to the model first as it can be controlled not only by the student (e.g., enroll in a buddy workout routine) but by schools, other stakeholders and policy makers. Sleep, eating behaviors and food choices, and substance use were entered subsequently. Substance use is the least amenable variable since its use or abstinence falls mostly on the students, regardless of interventions by the school. These data showed that eating behaviors and food choices explained the most variance in all four academic performance and commitment to learning models while physical activity explained the least amount of variance. Sleep and substance use explained a similar amount of variance in the academic achievement models, while sleep explained slightly more variance than substance use in the commitment to learning models. Both sleep and substance use could be influenced by schools and policy makers through school start times and educational initiatives such as drug prevention programs, however, the choice regarding both remains in the hands of the student themselves, which may be influenced by peer and family pressure or family commitments. On the other hand, physical activity, the factor that students, schools, policy makers, and possibly parents can manipulate the most and that does not necessarily rely on outside factors or economic, home, or other situations, explains the least variance. Meaning that it has the least impact on all three academic outcomes. Similarly, the odds of planning to attend a two- or

four-year college/university is mostly highly influenced by eating behaviors and food choices, sleep, and substance use; meanwhile, physical activity was least influential in increasing the odds of planning to attend a post-secondary educational institution. Therefore, the effect that factors outside of the school, school districts, and policy makers' control, have on academic achievement, commitment to learning, and academic aspirations warrants further investigation.

Implications

Large datasets such as the MSS enable the analysis of multiple variables with sufficient statistical power, leading to a holistic understanding of the various effects of predictor variables (e.g., health behaviors) on outcomes of interest (e.g., GPA). Having sufficient data also provides opportunities to include multiple racial/ethnic groups that are usually difficult to adequately sample. It is important to note that the factors included in this analysis are those that school districts can, at least partially, control and influence, which has the potential to directly or indirectly impact the students in their schools through their academic achievement, commitment to learning, and educational aspirations. When these factors are addressed and supported, schools have the power to provide the option for students to engage in healthy behavioral choices. Results such as those reported in this study warrant the attention of policymakers when making decisions for programs that could affect the way school districts provide services to students (e.g., House Bill 1295 and Senate Bill 5437 titled "Concerning breakfast after the bell programs", or policies about secondary school start times [See Wahlstrom (2016); Wheaton, Chapman, & Croft (2016)]). These results suggest that funds ought to be allocated to ensure that students are not food insecure since it impacts the academic outcomes, commitment to learning, and educational aspirations of students; such an initiative is already in place in a school district in Minnesota where all students are being provided with breakfast and lunch regardless of their parental income. These results are timely, especially with the recent focus on programs that target the health behaviors and choices of students regarding physical activity and food choices (e.g., www.choosemyplate.gov).

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Table 1
Descriptive Statistics for the 2013 and 2016 MSS data

		2013		2016	
		n	%	*n*	%
Control Variables					
Gender	Female	38,718	49.9	39,764	49.7
	Male	38,809	50.1	40,292	50.3
SES	Low	19,803	25.8	21,398	26.9
	High	56,866	74.2	58,177	73.1
Race	Asian American	4,416	5.7	4,989	6.2
	African American	4,038	5.2	4,818	6.0
	Hispanic	5,370	6.9	7,202	9.0
	Multiple Races	5,137	6.6	5,620	7.0
	White	58,566	75.5	57,596	71.8
Attendance	Missed Once or More	7,124	9.2	8,162	10.2
Independent Variables					
Physical Activity	*M* (*SD*)	4.0	(2.3)	4.0	(2.3)
Hours of Sleep	*M* (*SD*)	6.9	(1.3)	6.8	(1.3)
Food Security					
	Skipped Meals	3,532	4.7	3,572	4.6
	No Lunch	7,387	9.8	8,317	10.7
Healthy Food					
	Met Fruit Servings	26,835	36.3	27,876	36.2
	Met Veg Servings	16,477	22.2	16,322	21.2
Healthy Drinks					
	Met Milk Servings	22,819	30.8	20,454	26.5
	Met Water Servings	53,118	71.8	58,734	76.2
Junk Food Consumption					
	Soda	33,149	44.9	31,122	40.4
	Sports Drinks	23,985	32.5	22,603	29.4
	Energy Drinks	7,012	9.7	5,789	7.5
	Sugary Drinks	39,416	55.0	39,054	50.8
	Fast Food *M* (*SD*)	1.9	(0.9)	2.0	(1.0)
Tobacco Use	Daily	2,717	4.1	1,687	2.3
Alcohol Use[a]	High	6,236	9.3	4,914	6.8
Marijuana Use[b]	High	7,288	10.9	6,578	9.1
Dependent Variables					
GPA	*M* (*SD*)	3.1	(0.9)	3.1	(0.9)
Commitment to Learning	*M* (*SD*)	12.0	(1.5)	12.1	(1.5)
Educational Aspiration		61,843	79.8	64,172	80.0

Note: [a] = Daily, Once a week, and Twice a month Alcohol use; [b] = Daily, Once a week, Twice a month, and Once a month Marijuana use.

Table 2

Multiple regression results for grade point average dependent variable for 2013 cohorts

	Model 1			Model 2			Model 3			Model 4			Model 5		
	B		SE(B)	B		SE(B)	B		SE(B)	B		SE(B)	B		SE(B)
Intercept	3.45		0.01	3.22		0.01	2.65		0.02	2.90		0.02	2.25		0.03
Gender (Male)	-0.27	***	0.01 0.02	-0.31	***	0.01 0.03	-0.33	***	0.01 0.04	-0.28	***	0.01 0.03	-0.26	***	0.01 0.02
Grade (11th Grade)	-0.01	*	0.01 0.00	0.01		0.01	0.03	***	0.01 0.00	0.02	*	0.01 0.00	0.04	***	0.01 0.00
SES (Low)	-0.42	***	0.01 0.04	-0.40	***	0.01 0.03	-0.39	***	0.01 0.03	-0.34	***	0.01 0.03	-0.33	***	0.01 0.02
Race/Ethnicity (Ref = White)			0.02			0.02			0.02			0.01			0.01
Asian American	0.26	***	0.01	0.29	***	0.01	0.31	***	0.01	0.27	***	0.01	0.22	***	0.02
African American	-0.21	***	0.02	-0.18	***	0.02	-0.16	***	0.02	-0.12	***	0.02	-0.15	***	0.02
Multiple Races	-0.23	***	0.01	-0.22	***	0.01	-0.19	***	0.01	-0.17	***	0.01	-0.14	***	0.01
Hispanic	-0.30	***	0.01	-0.28	***	0.01	-0.27	***	0.01	-0.23	***	0.01	-0.24	***	0.01
Attendance (Missed)	-0.67	***	0.01 0.05	-0.66	***	0.01 0.04	-0.62	***	0.01 0.04	-0.49	***	0.01 0.03	-0.39	***	0.01 0.02
Physical Activity				0.05	***	0.00 0.01	0.04	***	0.00 0.01	0.03	***	0.00 0.01	0.03	***	0.00 0.01
Hours of Sleep							0.08	***	0.00 0.01	0.05	***	0.00 0.01	0.05	***	0.00 0.00
Food Security										0.24	***	0.01 0.02	0.21	***	0.01 0.01
Healthy Food										0.09	***	0.00 0.01	0.08	***	0.00 0.01
Healthy Drinks										0.03	***	0.01 0.00	0.03	***	0.01 0.00
Junk Food (No)										0.20	***	0.00 0.02	0.17	***	0.01 0.02
Tobacco Use (No)													0.38	***	0.02 0.01
Alcohol Use (No)													0.09	***	0.01 0.00
Marijuana Use (No)													0.24	***	0.01 0.01
ΔR				0.97%			1.07%			5.15%			1.46%		
R	14.48%			15.45%			16.52%			21.67%			23.13%		

*Note: *p* < .05. *** *p* < .001.

Table 3

Multiple regression results for grade point average dependent variable for 2016 cohorts

	Model 1			Model 2			Model 3			Model 4			Model 5		
	B	SE(B)		B	SE(B)		B	SE(B)		B	SE(B)		B	SE(B)	
Intercept	3.55	0.01		3.34	0.01		2.74	0.02		2.92	0.02		2.19	0.03	
Gender (Male)	-0.31 ***	0.01	0.03	-0.35 ***	0.01	0.04	-0.36 ***	0.01	0.04	-0.32 ***	0.01	0.03	-0.31 ***	0.01	0.03
Grade (11th Grade)	-0.07 ***	0.01	0.00	-0.05 ***	0.01	0.00	-0.01 *	0.01	0.00	-0.01	0.01		0.02 ***	0.01	0.00
SES (Low)	-0.41 ***	0.01	0.04	-0.39 ***	0.01	0.03	-0.39 ***	0.01	0.03	-0.32 ***	0.01	0.02	-0.32 ***	0.01	0.02
Race/Ethnicity (Ref = White)			0.02			0.02			0.02			0.01			0.01
Asian American	0.22 ***	0.01		0.25 ***	0.01		0.27 ***	0.01		0.22 ***	0.01		0.19 ***	0.01	
African American	-0.19 ***	0.01		-0.16 ***	0.01		-0.15 ***	0.01		-0.13 ***	0.01		-0.13 ***	0.02	
Multiple Races	-0.21 ***	0.01		-0.20 ***	0.01		-0.17 ***	0.01		-0.15 ***	0.01		-0.13 ***	0.01	
Hispanic	-0.30 ***	0.01		-0.28 ***	0.01		-0.27 ***	0.01		-0.23 ***	0.01		-0.23 ***	0.01	
Attendance (Missed)	-0.65 ***	0.01	0.05	-0.64 ***	0.01	0.05	-0.60 ***	0.01	0.04	-0.49 ***	0.01	0.03	-0.40 ***	0.01	0.02
Physical Activity				0.04 ***	0.00	0.01	0.04 ***	0.00	0.01	0.03 ***	0.00	0.01	0.03 ***	0.00	0.01
Hours of Sleep							0.09 ***	0.00	0.02	0.06 ***	0.00	0.01	0.05 ***	0.00	0.01
Food Security										0.22 ***	0.01	0.02	0.20 ***	0.01	0.01
Healthy Food										0.09 ***	0.00	0.01	0.08 ***	0.00	0.01
Healthy Drinks										0.03 ***	0.01	0.00	0.02 *	0.01	0.00
Junk Food (No)										0.19 ***	0.00	0.02	0.17 ***	0.00	0.02
Tobacco Use (No)													0.43 ***	0.02	0.01
Alcohol Use (No)													0.11 ***	0.01	0.00
Marijuana Use (No)													0.26 ***	0.01	0.01
ΔR				0.52%			1.36%			4.44%			1.29%		
R	15.69%			16.21%			17.57%			22.01%			23.30%		

*Note: *p* < .05. *** *p* < .001.

Table 4

Multiple regression results for Commitment to Learning dependent variable for 2013 cohorts

	Model 1			Model 2			Model 3			Model 4			Model 5		
	B	SE(B)		B	SE(B)		B	SE(B)		B	SE(B)		B	SE(B)	
Intercept	12.31	0.01		11.96	0.02		10.54	0.03		10.90	0.04		9.86	0.05	
Gender (Male)	-0.27 ***	0.01	0.01	-0.33 ***	0.01	0.01	-0.37 ***	0.01	0.02	-0.29 ***	0.01	0.01	-0.27 ***	0.01	0.01
Grade (11th Grade)	-0.06 ***	0.01	0.00	-0.03 ***	0.01	0.00	0.03 *	0.01	0.00	0.01	0.01		0.07 ***	0.01	0.00
SES (Low)	-0.19 ***	0.01	0.00	-0.16 ***	0.01	0.00	-0.13 ***	0.01	0.00	-0.06 ***	0.01	0.00	-0.05 ***	0.01	0.00
Race/Ethnicity (Ref = White)			0.01			0.01			0.01			0.01			0.01
Asian American	0.55 ***	0.02		0.60 ***	0.02		0.62 ***	0.02		0.55 ***	0.02		0.45 ***	0.03	
African American	0.36 ***	0.03		0.39 ***	0.03		0.44 ***	0.03		0.45 ***	0.03		0.38 ***	0.03	
Multiple Races	-0.17 ***	0.02		-0.16 ***	0.02		-0.10 ***	0.02		-0.09 ***	0.02		-0.07 ***	0.02	
Hispanic	0.03	0.02		0.05 *	0.02		0.08 ***	0.02		0.11 ***	0.02		0.10 ***	0.02	
Attendance (Missed)	-1.03 ***	0.02	0.04	-1.02 ***	0.02	0.04	-0.93 ***	0.02	0.03	-0.77 ***	0.02	0.02	-0.61 ***	0.02	0.01
Physical Activity				0.07 ***	0.00	0.01	0.06 ***	0.00	0.01	0.04 ***	0.00	0.00	0.04 ***	0.00	0.00
Hours of Sleep							0.21 ***	0.00	0.03	0.17 ***	0.00	0.02	0.15 ***	0.00	0.02
Food Security										0.24 ***	0.01	0.01	0.20 ***	0.01	0.00
Healthy Food										0.22 ***	0.01	0.01	0.21 ***	0.01	0.01
Healthy Drinks										0.14 ***	0.01	0.00	0.13 ***	0.01	0.00
Junk Food (No)										0.26 ***	0.01	0.02	0.22 ***	0.01	0.01
Tobacco Use (No)													0.32 ***	0.03	0.00
Alcohol Use (No)													0.42 ***	0.02	0.01
Marijuana Use (No)													0.44 ***	0.02	0.01
ΔR				1.12%			2.86%			4.20%			2.37%		
R	5.96%			7.08%			9.94%			14.14%			16.51%		

*Note: *p* < .05. *** *p* < .001.

Table 5

Multiple regression results for Commitment to Learning dependent variable for 2016 cohorts

	Model 1			Model 2			Model 3			Model 4			Model 5		
	B		SE(B)	B		SE(B)	B		SE(B)	B		SE(B)	B		SE(B)
Intercept	12.39		0.01	11.99		0.02	10.44		0.03	10.78		0.03	9.67		0.05
Gender (Male)	-0.27	***	0.01 0.01	-0.33	***	0.01 0.01	-0.38	***	0.01 0.02	-0.32	***	0.01 0.01	-0.31	***	0.01 0.01
Grade (11th Grade)	-0.14	***	0.01 0.00	-0.10	***	0.01 0.00	-0.02		0.01	-0.02		0.01	0.04	***	0.01 0.00
SES (Low)	-0.22	***	0.01 0.00	-0.18	***	0.01 0.00	-0.17	***	0.01 0.00	-0.08	***	0.01 0.00	-0.09	***	0.01 0.00
Race/Ethnicity (Ref = White)			0.01			0.01			0.01			0.01			0.01
Asian American	0.43	***	0.02	0.49	***	0.02	0.52	***	0.02	0.44	***	0.02	0.38	***	0.02
African American	0.40	***	0.02	0.44	***	0.02	0.47	***	0.02	0.47	***	0.02	0.42	***	0.03
Multiple Races	-0.18	***	0.02	-0.18	***	0.02	-0.12	***	0.02	-0.10	***	0.02	-0.07	***	0.02
Hispanic	0.04	*	0.02	0.07	***	0.02	0.10	***	0.02	0.12	***	0.02	0.11	***	0.02
Attendance (Missed)	-0.93	***	0.02 0.03	-0.90	***	0.02 0.03	-0.80	***	0.02 0.03	-0.66	***	0.02 0.02	-0.53	***	0.02 0.01
Physical Activity				0.08	***	0.00 0.01	0.07	***	0.00 0.01	0.05	***	0.00 0.00	0.05	***	0.00 0.00
Hours of Sleep							0.23	***	0.00 0.04	0.19	***	0.00 0.03	0.18	***	0.00 0.02
Food Security										0.25	***	0.01 0.01	0.21	***	0.01 0.00
Healthy Food										0.24	***	0.01 0.02	0.23	***	0.01 0.02
Healthy Drinks										0.17	***	0.01 0.00	0.16	***	0.01 0.00
Junk Food (No)										0.23	***	0.01 0.01	0.20	***	0.01 0.01
Tobacco Use (No)													0.39	***	0.04 0.00
Alcohol Use (No)													0.35	***	0.02 0.00
Marijuana Use (No)													0.48	***	0.02 0.01
ΔR				1.26%			3.58%			4.10%			1.86%		
R	5.61%			6.87%			10.45%			14.55%			16.41%		

Note: $*p < .05$. $*** p < .001$.

Table 6

Logistic regression results for variables predicting Educational Aspirations for 2013 cohorts

	Model 1			Model 2			Model 3			Model 4			Model 5		
	B		SE(B)	B		SE(B)	B		SE(B)	B		SE(B)	B		SE(B)
Intercept	1.86		0.02	1.58		0.03	0.70		0.06	1.10		0.07	0.25		0.09
Gender (Male)	-0.66	***	0.02 0.52	-0.71	***	0.02 0.49	-0.75	***	0.02 0.47	-0.71	***	0.02 0.49	-0.70	***	0.02 0.50
Grade (11th Grade)	0.47	***	0.02 1.59	0.49	***	0.02 1.64	0.53	***	0.02 1.71	0.52	***	0.02 1.68	0.58	***	0.02 1.78
SES (Low)	-0.70	***	0.02 0.50	-0.68	***	0.02 0.51	-0.66	***	0.02 0.52	-0.60	***	0.02 0.55	-0.59	***	0.03 0.55
Race/Ethnicity (Ref = White)															
Asian American	0.31	***	0.04 1.37	0.39	***	0.04 1.48	0.41	***	0.05 1.51	0.43	***	0.05 1.53	0.38	***	0.05 1.47
African American	0.29	***	0.04 1.33	0.32	***	0.05 1.38	0.37	***	0.05 1.45	0.42	***	0.05 1.52	0.43	***	0.06 1.53
Multiple Races	-0.26	***	0.04 0.77	-0.25	***	0.04 0.78	-0.21	***	0.04 0.81	-0.21	***	0.04 0.81	-0.23	***	0.04 0.80
Hispanic	-0.22	***	0.03 0.80	-0.19	***	0.04 0.82	-0.18	***	0.04 0.84	-0.14	***	0.04 0.87	-0.14	**	0.04 0.87
Attendance (Missed)	-0.81	***	0.03 0.45	-0.80	***	0.03 0.45	-0.75	***	0.03 0.47	-0.58	***	0.03 0.56	-0.46	***	0.04 0.63
Physical Activity				0.06	***	0.00 1.06	0.06	***	0.00 1.06	0.04	***	0.00 1.04	0.04	***	0.01 1.05
Hours of Sleep							0.13	***	0.01 1.14	0.08	***	0.01 1.09	0.08	***	0.01 1.09
Food Security										0.44	***	0.02 1.56	0.42	***	0.02 1.52
Healthy Food										0.13	***	0.01 1.13	0.11	***	0.02 1.12
Healthy Drinks										0.00		0.02	-0.01		0.02
Junk Food (No)										0.17	***	0.01 1.19	0.14	***	0.02 1.15
Tobacco Use (No)													0.65	***	0.05 1.92
Alcohol Use (No)													0.19	***	0.04 1.21
Marijuana Use (No)													0.07		0.04
ΔR				0.002			0.004			0.014			0.003		
pseudo R	0.059			0.061			0.065			0.079			0.082		

Note: *** $p < .001$.

Table 7

Logistic regression results for variables predicting Educational Aspirations for 2016 cohorts

	Model 1			Model 2			Model 3			Model 4			Model 5		
	B		SE(B)	B		SE(B)	B		SE(B)	B		SE(B)	B		SE(B)
Intercept	1.95		0.02	1.62		0.03	0.79		0.06	1.22		0.06	0.25		0.09
Gender (Male)	-0.66	***	0.02 0.52	-0.72	***	0.02 0.49	-0.75	***	0.02 0.47	-0.73	***	0.02 0.48	-0.74	***	0.02 0.48
Grade (11th Grade)	0.30	***	0.02 1.36	0.34	***	0.02 1.41	0.38	***	0.02 1.46	0.39	***	0.02 1.47	0.44	***	0.02 1.56
SES (Low)	-0.77	***	0.02 0.46	-0.75	***	0.02 0.47	-0.74	***	0.02 0.48	-0.67	***	0.02 0.51	-0.67	***	0.02 0.51
Race/Ethnicity (Ref = White)															
Asian American	0.53	***	0.04 1.71	0.61	***	0.04 1.84	0.63	***	0.05 1.88	0.59	***	0.05 1.80	0.55	***	0.05 1.74
African American	0.43	***	0.04 1.54	0.47	***	0.04 1.59	0.48	***	0.04 1.62	0.54	***	0.05 1.72	0.52	***	0.05 1.68
Multiple Races	-0.15	***	0.03 0.86	-0.13	***	0.04 0.87	-0.10	**	0.04 0.90	-0.07		0.04	-0.06		0.04
Hispanic	-0.22	***	0.03 0.80	-0.19	***	0.03 0.83	-0.18	***	0.03 0.84	-0.11	***	0.03 0.90	-0.13	***	0.04 0.88
Attendance (Missed)	-0.74	***	0.03 0.48	-0.71	***	0.03 0.49	-0.66	***	0.03 0.52	-0.49	***	0.03 0.61	-0.40	***	0.03 0.67
Physical Activity				0.07	***	0.00 1.07	0.06	***	0.00 1.06	0.05	***	0.00 1.05	0.05	***	0.00 1.05
Hours of Sleep							0.13	***	0.01 1.13	0.07	***	0.01 1.07	0.06	***	0.01 1.06
Food Security										0.41	***	0.02 1.51	0.40	***	0.02 1.49
Healthy Food										0.07	***	0.01 1.07	0.06	***	0.01 1.06
Healthy Drinks										0.11	***	0.02 1.11	0.11	***	0.02 1.12
Junk Food (No)										0.27	***	0.01 1.31	0.24	***	0.01 1.27
Tobacco Use (No)													0.73	***	0.06 2.09
Alcohol Use (No)													0.13	**	0.04 1.14
Marijuana Use (No)													0.19	***	0.04 1.21
ΔR				0.002			0.004			0.017			0.004		
pseudo R	0.057			0.059			0.063			0.080			0.084		

Note: ** $p < .01$; *** $p < .001$.

Appendix A

Factor Structure for the Commitment to Learning Scale

	Factor Loadings
1. How often do you care about doing well in school?	0.79
2. How often do you pay attention in class?	0.75
3. How often do you go to class unprepared?	0.39
4. If something interests me, I try to learn more about it.	0.35
5. I think things I learn at school are useful.	0.65
6. Being a student is one of the most important parts of who I am.	0.66
7. During a typical school day, how many hours do you study or do homework outside of school?	0.41
8. Have a hard time paying attention in school, work or home. (reversed)	0.51